HNOLOGY DEPT

Devoted to
TEXTILE
CHEMISTRY
BLEACHING
DYEING
PRINTING
FINISHING

OVEMBER 23, 1942
OLUME 31, No. 24

FFICIAL PUBLICATION
of the
PROCEEDINGS
ERICAN ASSOCIATION
TEXTILE CHEMISTS
AND COLORISTS

AMERICAN DYESTUFF REPORTER

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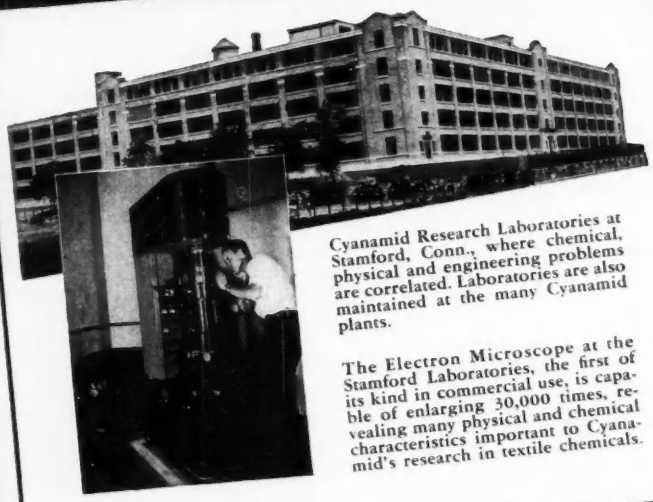

Cyanamid Research Laboratories at Stamford, Conn., where chemical, physical and engineering problems are correlated. Laboratories are also maintained at the many Cyanamid plants.

The Electron Microscope at the Stamford Laboratories, the first of its kind in commercial use, is capable of enlarging 30,000 times, revealing many physical and chemical characteristics important to Cyanamid's research in textile chemicals.

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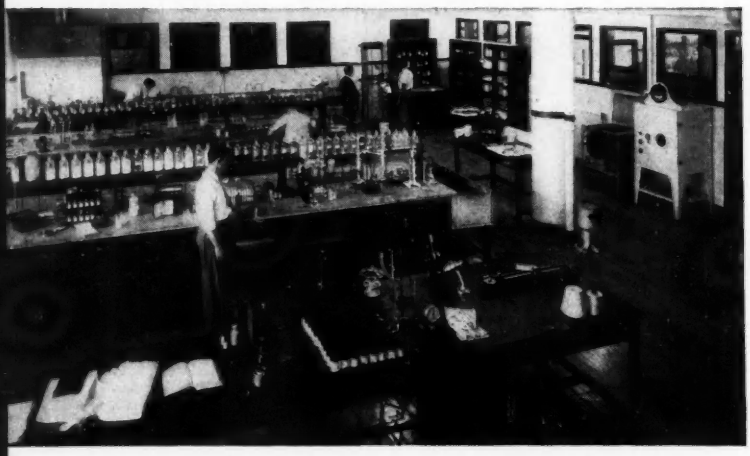

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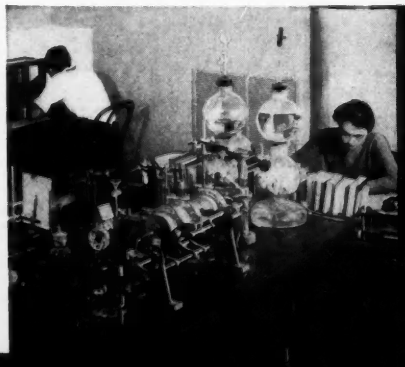

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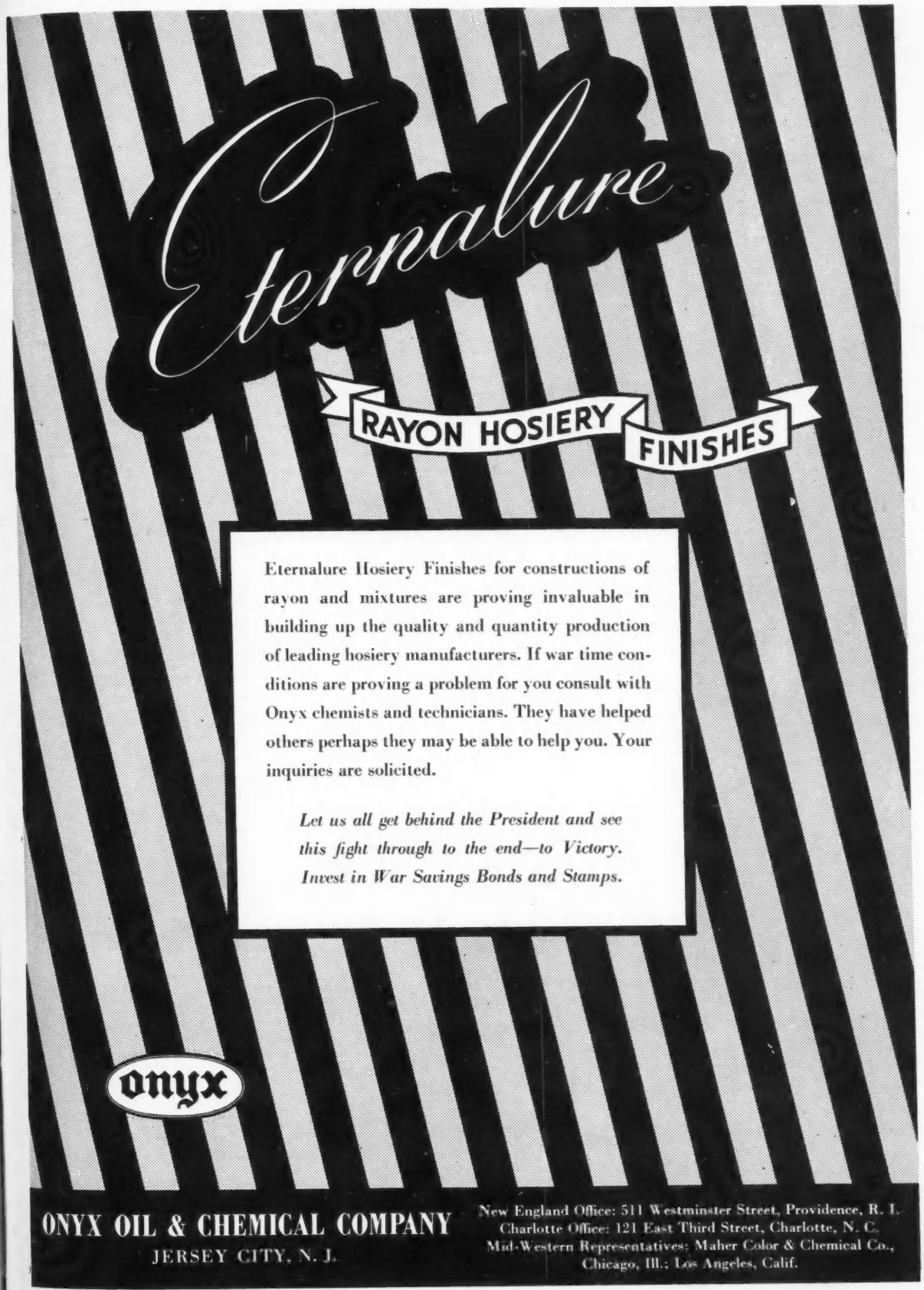
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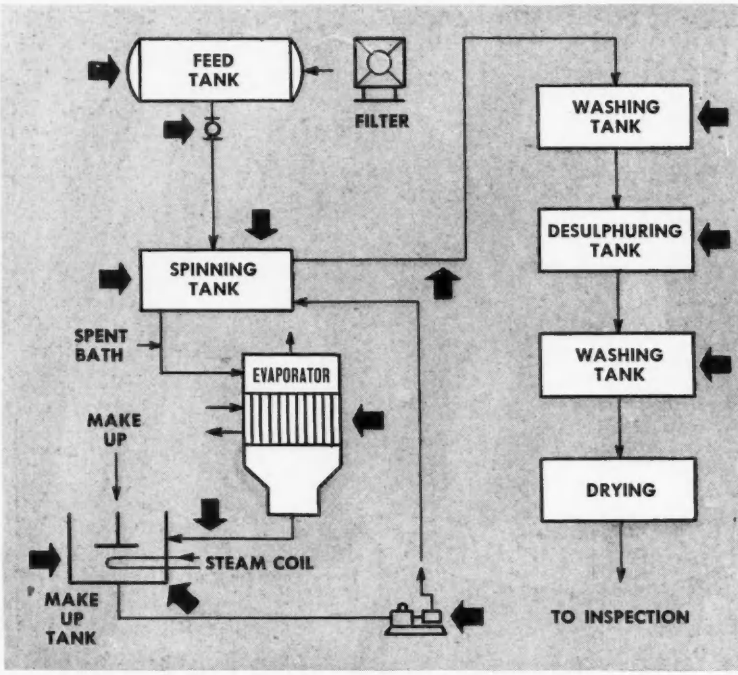

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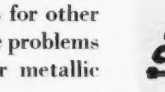
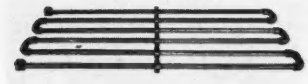
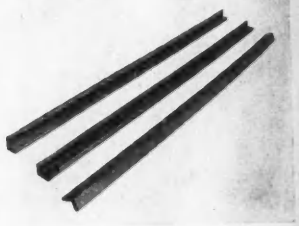


Heating Coil



Section of Washing Tank



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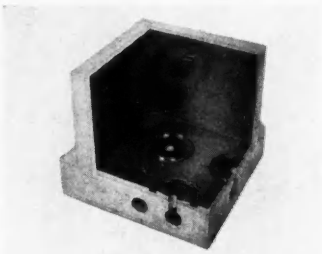

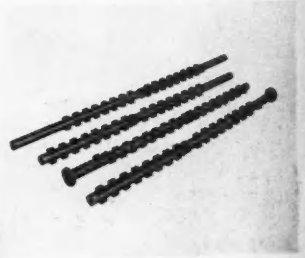

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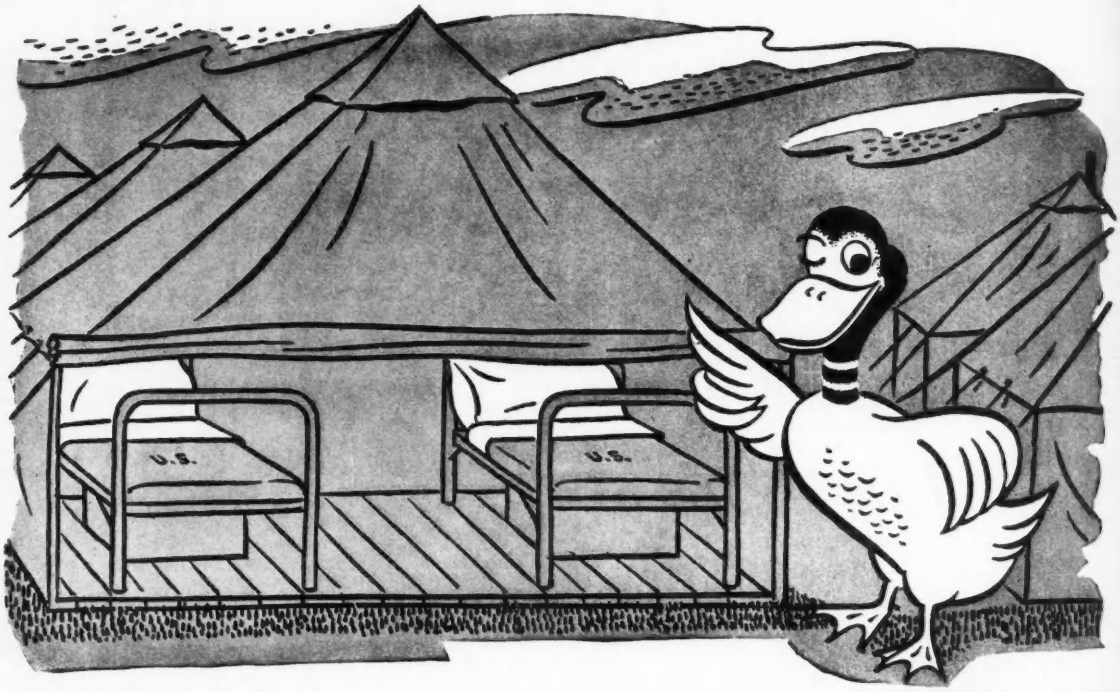

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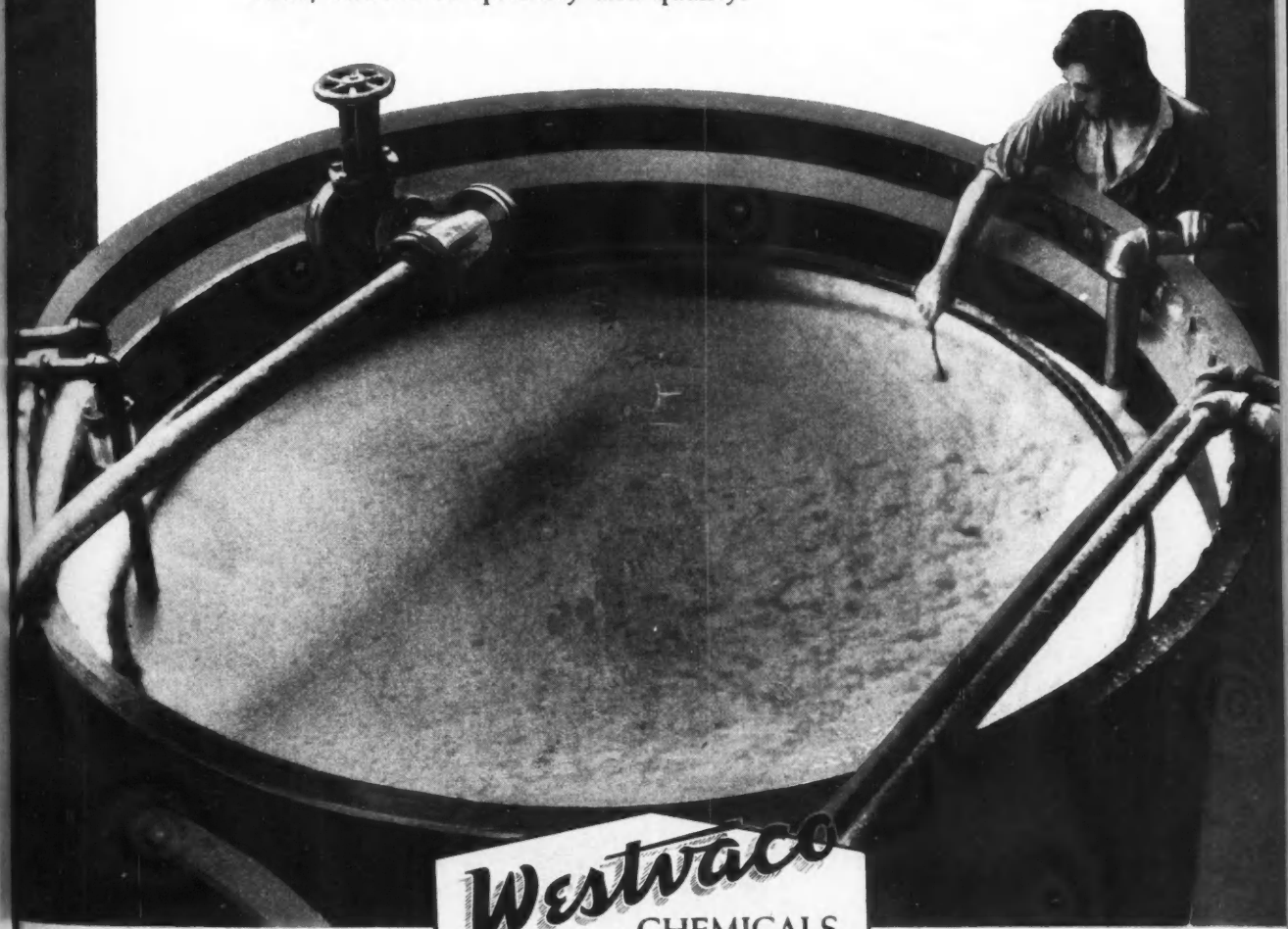

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NOVEMBER 23, 1942

VOLUME 31 NUMBER 24

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NOVEMBER 23, 1942

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Members should notify the **Secretary** immediately of all address changes.

MEETING, NEW YORK SECTION

A MEETING of this section was held on Friday evening, November 6th, at the Downtown Athletic Club, New York City.

The chairman of the technical program committee, Emmett J. Driscoll, announced that the next meeting would be held on December 4th at the Downtown Athletic Club and that the dyeing and finishing of woolen fabrics for the Navy would be discussed.

A letter from Dr. Louis A. Olney, chairman of the committee of judges for the Intersectional Contest, was read by Henry F. Herrmann, chairman of the national publicity committee. It stated that first prize in the contest had again been awarded to the New York Section. It was indicated that our paper had received 22 out of a possible 24 votes.

Dr. Arnold Lippert of the War Production Board delivered an address which discussed "Dyestuff Conservation Order M-103." This proved to be exceptionally informative and was well received. Considerable discussion followed.

Among the guests at the speaker's table were Edward A. MacKinnon, chairman of the Canadian Dyestuff Advisory Committee; W. R. MacIntyre, president of the National Association of Finishers of Textile Fabrics; George Lanier, War Production Board; Howard Fletcher, executive secretary of the Silk and Rayon Dyers and Printers Association; Lt. Cmdr. W. F. Prien, Brooklyn Naval Clothing Depot; Major Frank M. Steadman, Philadelphia Quartermaster Depot. There were also many present from associations in the dyeing and printing field, the Dyestuff Advisory Committee and the OPA.

The total attendance was 256.

Respectfully submitted,

NORMAN A. JOHNSON, *Secretary.*

MICROBIOLOGY

of Textile Fibers*

W. S. MARSH

Bacteriologist, United States Testing Co., Inc.

THE purpose of this talk is to acquaint you with the types of bacteria that are native to the various textile fibers. In order not to confuse you we shall discuss textile bacteria without using too much scientific terminology.

Bacteria are so small that to the unaided vision one cannot ssee them as individuals. They exist everywhere in nature. In this room they are present in the air; we have eaten them in the food we have just partaken of; they are on the floor; on this table and last but not least, in and on the clothes we wear. Yet we do not see them unless with the aid of a microscope. The average bacterium is approximately 1/25,000 of an inch long. In fact millions of bacteria could be located on the point of a common pin. However, it has been computed that if one individual bacterial cell were allowed to reproduce under optimum conditions, in twenty-four hours time that one bacterium would have progeny sufficient to fill a one-inch pipe extending from New York to San Francisco, and if allowed to reproduce for another twenty-four hours would create a mass several times the size of the earth. Fortunately, Nature does not allow such rate of growth.

Let us very briefly discuss the appearance of the various types of bacterial cells. Certain "bacilli" are rod shaped organisms. Those which appear as little round dots are known as cocci. "S" shaped organisms are classified as spirochaetes. The common yeasts are oblong or oval while those known as fungi possess very complex structures. Some of the above mentioned types of organisms are motile and others are non-motile.

Rather than to further discuss these organisms which you cannot see without the aid of a microscope I have brought examples of living ones with me which are growing in such numbers that they are visible to you. I will pass around among you types of bacteria common to the textile industry. These are not the organisms of the medical bacteriologists but those common in the air, soil and water. Some are fungi and molds and others the single cell bacilli. I'll ask that you handle these plates with care. The proper way to examine them is to hold the plate up to the light where you easily see a myriad of forms of the various types. On the back of these plates you will find a description of the particular organism. You will undoubtedly immediately recognize some of them as common molds or mildew.

Chairman Tisdale: Are they supposed to be moving?

Mr. Marsh: They are alive but you will see no visible motion. This organism is known as *Chaetomium globosum* and possesses the specific property of decomposing cellulosic material such as cotton. The second plate is known as *Aspergillus niger* and is present in common mildew conditions which we have all seen on bread, etc., that was left in a moist, warm condition for a few days.

Mr. Reeser: If they have no air how do they live?

Mr. Marsh: There is sufficient air in these plates. This outside rubber cover is merely a protective measure.

Each of these plates possesses millions of organisms, in fact astronomical numbers of individuals, yet each plate is made from but 1/1,000 of a cubic centimeter of a water suspension of organisms native to textile fibers.

. . . (18 *plates were passed around*) . . .

Mr. Freedman: Are molds and yeast considered as bacteria?

Mr. Marsh: Yes, they are classified under the general heading of bacteria. Molds differ from the bacteria and yeast, which are uniform in shape and dimensions, in that they are multicellular.

Mr. Freedman: Do molds and yeast grow the same way? Do they propagate the same way?

Mr. Marsh: Yeast reproduces by a process known as budding while molds reproduce by branching out and releasing millions of cells called spores. Molds grow better under acid conditions than do the bacteria which reproduce most readily under alkaline conditions.

Common mold or mildew is today a very pressing problem in the textile industry. Most of us believe that mildew from a bacteriological viewpoint is the most urgent problem in the textile industry. This is true to us because most mildew is visible. Bacterial decomposition of textile fibers through the growth of common soil, air and water bacteria brings about marked weakening or tendering of the various fibers. Molds grow readily on the fiber surface while bacteria are native to even the very innercellular structure of all vegetable and animal fibers. Even synthetic fibers are infected. Bacterial growth causes serious tendering of textiles.

Mr. Freedman: Are all classes of bacteria deleterious to fabrics? I am referring to the spirochaete and the bacillus.

Mr. Marsh: Yes and no. To answer your question let us suppose that we bury in a fertile soil a sample of

* Presented at meeting, New York Section, May 22, 1942.

cotton fabric. In from a week to ten days time you will discover that the fabric is at least partially, if not completely, decomposed. It has been shown that this destruction of the fiber may be brought about by one type of organism. This one organism has taken a particular liking or shall we say has acquired an appetite for the cellulose of the cotton fiber. This one organism may so acclimatize itself to prevalent conditions that it gains a preponderance in numbers. The growth of large numbers of one organism on the cotton may cause complete disintegration of the fabric. Such growth may result in a fermentation or enzymatic hydrolysis of the cellulose of the fiber.

In the laboratory it is possible to decompose cellulose fiber in a very short period of time with ferments or enzymes, known as cellulases, derived from cellulose decomposing bacteria.

Mr. Coogan: In other words the soil is responsible for the particular bacteria that destroy cellulose.

Mr. Marsh: Yes.

Mr. Coogan: And the bacteria multiply in such numbers as to quickly decompose the cellulose?

Mr. Marsh: Yes. Bacteria reproduce by gaining nutrition from a substance such as cellulose and can digest large quantities.

Mr. Dannerth: Is the action the same on greige and finished goods?

Mr. Marsh: Goods either in the greige or finished states may be destroyed by bacteria. However, some finished or dyed goods may possess bacteriostatic properties because of the nature of the finish or dye. Nevertheless, certain types of bacteria can adjust themselves in time to such a condition of bacteriostasis even though that condition formerly was toxic to them.

Mr. Dannerth: Do you find that wax protects fibers?

Mr. Marsh: Not altogether, although waxes, as some dyes do, may possess inhibitory qualities.

Chairman Tisdale: Did I understand you to say, Mr. Marsh, that all synthetic fibers are not immune to bacteria and mold?

Mr. Marsh: All synthetic fibers are not immune to action or growth of bacteria and mold. Since processing in the textile industry is basically the same for synthetics as for the natural fibers, bacteria have present similar agents for nutrition. The use of finishing agents such as starches, oils and other sizing materials is quite similar for both types of fibers. The various finishing agents used may in themselves infect fibers. You will note one of the plates you have examined showed bacteria isolated from a sulfonated oil. Processing conditions of high humidity, darkness and optimum temperature are conducive to decomposition of synthetic fibers as well as natural fibers because of the presence of proper nutrition for bacterial growth.

Chairman Tisdale: What I had reference to was Vinyon. I understood this fiber was immune to mildew.

Mr. Marsh: No fiber is 100 per cent resistant to mildew or bacterial attack. Somewhere on earth there is undoubtedly a type of organism which will specifically decompose Vinyon. Such a fiber may be regarded as more highly resistant to common mold and mildew attack than are some of the natural fibers.

Mr. Freedman: When you use the term "bacteriostatic" do you include molds as well as bacteria?

Mr. Marsh: When we speak of inhibiting mold growth we use the term "fungistatic."

Mr. Freedman: Are the soil bacteria aerobic or anaerobic?

Mr. Marsh: They are both although the greater percent are aerobic.

Mr. Dannerth: I think you might want to modify your statement about every textile fiber being subject to mildew because I don't think glass fiber is.

Mr. Marsh: In the presence of suitable nutritive agents such as finishes, mildew organisms could reproduce to such an extent to lead to a mildew condition. However, the glass fiber itself would probably not be attacked.

Mr. Barnett: Do bacteria flourish in the mineral world as well?

Mr. Marsh: Yes there are bacteria present in most minerals. The growth of many bacteria is greatly stimulated by the presence of small amounts of various minerals such as iron, and so forth.

I have brought a few charts which show roughly, from laboratory tests, the numbers of bacteria to be found on various textile fibers.

NUMBER OF ORGANISMS PRESENT ON TEXTILE MATERIALS

Cotton—Per Sq. In. Sample		*Wool—Per Sq. In.* Sample		*Silk—Per Sq. In.* Sample	
A	80,000,000	A	2,880,000	A	1,705,000
B	9,808,000	B	2,900,000	B	2,320,000
C	2,933,500	C	2,870,000	C	2,155,000
D	5,875,000	D	3,740,000	D	1,980,000
E	1,967,000	E	4,275,000	E	2,015,000
F	202,500,000				
G	1,184,000				
H	54,500,000				
I	12,750,000				
J	3,150,000				
K	7,500,000				
L	2,466,500				
	32,054,417	*Averages*:	3,540,000		2,235,000

Cotton generally possesses greater bacterial numbers than do other fibers. One sample may possess 80,000,000 or more organisms per square inch of cotton fiber. Counts showed others possess from 9,000,000 to 202,000,000. An average of counts has shown that cotton fabric tested possessed over 32,000,000 organisms per square inch of fabric, and that there are many different types of organisms included in those 32,000,000. The organisms found in cotton can be found in the cotton fields as they are common soil bacteria native to the cotton fiber. Cotton decomposing organisms are found in cotton to a high degree.

Few of them are ever found on wool. In other words, they are native to cotton.

On dry wool, bacterial counts generally run much less. Experiments have indicated an average of 3,500,000 organisms per square inch of woolen fabric.

The difference between wool and cotton bacterial populations is that on wool, we find very few molds, but large numbers of one or two types or classes of bacteria. One of these plates which you have examined contains an organism identified as *B. mesentericus*. That organism may comprise 50 per cent or more of the organisms present on wool. In forty hours time or less it can completely decompose wool fiber under conditions of high moisture, humidity, darkness, and temperature. There are also secondary fermentation reactions concerned with the growth of this particular organism.

On silk, bacterial numbers are generally less than on other textiles. We find protein decomposing organisms specific for silk. However, silk is fairly resistant to bacterial attack, outside of cocoons becoming infected. Pasteur's famous laboratory experiments proved that bacteria cause widespread silk diseases.

Synthetic fibers vary greatly in bacterial numbers, from very few, up into the hundreds of millions. Processing conditions and agents cause varying degrees of infection.

The essential feature of the numbers and types of organisms on the synthetic fibers are derived from the type of solution and the ingredients which go into the makeup of that fiber.

Mr. Dannerth: Is there any hope of destroying the bacteria in the raw material by use of fungicides or bactericides?

Mr. Marsh: Yes, and I am coming to that, in just a moment.

. . . (*Exhibits of fabrics passed among audience*) . . .

We have spoken tonight of a type of organism which decomposes cotton fiber. Here is one sample of Osnaburg fabric, with practically no organisms. It has been treated with a germicide. This fabric is in a bacteriostatic condition. This sample, and an untreated sample, both have been buried in moist soil for four days. Organisms have so grown as to render the untreated fabric very weak. It has become discolored from bacterial growth. The germicide treated fabric shows no such discoloration or tendering after soil burial.

Here we have an interesting sample of cotton fabric. This fabric was continually wet. After a short period of time organisms began to grow, and now it practically falls apart.

This type of damage may be prevented. However, too few preventative measures have been undertaken by the textile industry. We believe it is possible to incorporate germicidal substances in fibers, which will result in that fabric's tensile strength being maintained to a high degree in the presence of bacterial attack.

Eighty per cent of the loss of tensile strength of textile fibers in processing may be attributed to bacterial growth. Prevent bacterial growth processes on textile fibers and we have longer lasting fabrics.

Now let us consider the effect of this particularly offensive organism—*Bacillus mesentericus*—and its action on wool.

In our wool industry, we have found that the tendering of wool can be traced to the growth of this type of organism. As I stated before, this organism comprises a very large per cent of the bacterial population of the wool. The wool fabric becomes increasingly subject to attack as a result of starching, sizing, crabbing, scouring and the processing operations, in that the fabric now possesses necessary bacterial nutrition. Tremendous numbers of these organisms grow, and emit offensive putrefactive odors. The visible effect of the growth of these particular organisms on wool are "resist" areas, after dyeing. Spots develop on the fabrics.

You will notice that these samples of worsted fabrics, which now contain millions of organisms, are shaded and that there are many tan and white areas. In other words, the affinity of the fiber for the particular dye has been so altered that the bacterially damaged area does not dye the desired shade. These arrows indicate white and tan areas on the fabrics. They were not produced by laboratory experiments, but, under actual mill conditions. These defects in woolen fibers mean that the fabric has to be regraded, redyed or discarded.

If the damage from bacterial growth has proceeded too far it is practically impossible, by redyeing the fabric, to cover up the affected area.

Let us now discuss textile bacterial control. What measures are there and what can be done to stop the ravages of bacterial growth in the textile industry? Let us remember that the bacteria are present in the air, are native to the fiber, are in the water, and wherever there exists a condition of dirt or filth. It is relatively easy to infect a mill, especially where good cleaning methods are not practiced.

In order to eliminate air bacteria, there is one very efficient method. The air of a mill is often warm, damp and very moist. Visible mold appears on the ceilings, walls and floors, often in the machinery. Then the organisms native to the cloth begin to reproduce. Storage of the cloth becomes a problem. The proper use of ultraviolet bactericidal radiation can remove 99.99 plus per cent of air-borne bacteria. That is, we do not allow airborne organisms a chance of further infecting the stored fabrics.

What actually happens is that this lamp emanates bactericidal rays of a very short wave length of 2537 Angstroms. The active radiation is invisible and is similar to that used to radiate milk.

These ultra short rays, within a 24 foot range, kill all air-borne organisms.

Let us now discuss germicides. There are many different germicides and chemicals which have been used by the textile industry. However, a large per cent of these germicides, chemicals, fungicides may impart some undesired element to the fabric, or must be used in such concentration that they are too expensive or give the fabric an offensive odor, or change finishing qualities or even change the very nature of the fabric itself.

We have experimented with many compounds which may be added to fabrics with relative impunity. Notice on this untreated fabric that bacteria grow next to and on the fabric while on the treated fabric bacteria are not present nearer than one-half inch. We have done considerable laboratory work on germicidal products which remain germicidally active even after repeated washings of the fabric. Some treated fabrics withstand as many as thirty or more washings and still retain bacteriostatic qualities. This is a plate showing a fabric which has been washed forty times and still retains bacteriostatic values.

Here is another fabric which is bacteriostatic against typhoid organisms. This means that a germicide has been added which has rendered the fabric actively antiseptic so that it is in a highly hygienic condition.

. . . (*Exhibit of Photographs*) . . .

Here are other samples of bacteriostatic fabrics. The test organisms are of the type associated with the condition known as "athlete's foot." The treated fabric shows no growth of these organisms nearer than two inches of the fabric whereas, the untreated fabric is covered with growth.

Here again, we have a plate of three samples of fabric treated with bacteriostatic agents. The fabrics were washed thirty times and still remained bacteriostic. Each washing consisted of agitating the fabrics in 2 per cent soap solutions for five minutes at 180 degrees F. followed by five thorough rinsings.

Mr. Freedman: After it was washed, was the fabric subjected to the air for any length of time or was it immediately tested?

Mr. Marsh: It was dried and tested after washing in this case.

Mr. Freedman: Have you tested them after they have been stored or left standing for a considerable period of time?

Mr. Marsh: In some cases we have tested samples after more than 250 days of storage and found them to retain their bacteriostatic qualities.

Member: At what temperature were they stored?

Mr. Marsh: At room temperature.

Mr. Uzenoff: Did you test the fabric for bacteriostasis by other methods?

Mr. Marsh: The Petri dish method is a standard testing procedure for bacteriostasis determinations. The technique employed is similar to that outlined in bulletin 198, U.S. Department of Agriculture. We do, however, conduct many bacteriological textile tests by other methods generally in accordance with Government specifications.

Mr. Freedman: Are the most effective bacteriostatic agents organic chemicals?

Mr. Marsh: The newly developed germicides are mostly organic in nature. The ideal germicide should be nontoxic under conditions of use, have no objectionable odor, possess good penetrating properties and be retained by the fabric.

Mr. Duvois: Have you found any material to withstand the rot-proofing test outside of metallic salt?

Mr. Marsh: When you refer to rot-proofing test you mean the soil-burial test?

Mr. Duvois: Yes.

Mr. Marsh: We are carrying out a number of such experiments. We have experimented with various compounds. To date we have found that a germicide which is effective as a mildewproofing agent for sandbags may not be suitable for camouflage fabric. A specific germicide must be used for the particular conditions to which the fabric is exposed.

Mr. Coogan: It would necessarily follow the specific cloth it was to work on too, wouldn't it?

Mr. Marsh: Yes. So many factors enter into mildewproofing that it is a research problem to find a universal germicide or application. Some germicides which are active on cotton fabrics may not be active on woolen fabrics.

Mr. Freedman: What organism is responsible for the deterioration of bathing suits?

Mr. Marsh: That depends on the nature of the fabric.

Mr. Freedman: A wool bathing suit, I should say.

Mr. Marsh: There are several. Bathing suits, in the tropic regions and in the south decompose quite rapidly. The decomposing organism is probably the *B. mesentericus* type or a wool decomposing fungus. The mode of destruction is evidently a trypsin-like digestion of the fiber. The hard scales of the fiber are first dissolved and then the inner fiber structure is further decomposed by enzymatic action.

Mr. Freedman: Is the same organism responsible for the deterioration of bathing suits used on the seashore?

Mr. Marsh: I have not given much thought to that question but believe that the *mesentericus* organism, having adjusted itself to salt water conditions, could bring about fiber decomposition. I doubt if salt water would kill or remove *mesentericus* organisms from wool fiber. Bacteria adhere to fiber with great tenacity.

Mr. Freedman: Does the application of wetting agents aid in their removal?

Mr. Marsh: Wetting agents might aid in the removal of bacteria from fibers. It is also interesting to note that some wetting agents possess bactericidal properties. This is unusual as most bacteria can endure the presence of strong chemical agents. The bactericidal action of some wetting agents may be attributed to changes in surface tension phenomena.

Some organisms are also heat resistant. *B. mesentericus* and its spores are in this class. This organism has been shown to be viable after six hours boiling.

Mr. Freedman: Then it is the spore that is alive?

Mr. Marsh: Yes.

Mr. Freedman: Would a repeated boiling on three successive days kill all life?

Mr. Marsh: Intermittent heating would kill spores more readily than one continuous heating.

Member: Is *mesentericus* resistant to acid and alkali?

Mr. Marsh: The spores of *mesentericus* are quite resistant to such agents. One can judge the damage brought about by an organism by the specificity and speed with which it decomposes a particular fabric. *Chaetomium globosum* in large numbers will completely decompose cellulose in from 24 hours to 8 days time as it is a specific cellulose digesting organism. The final destruction is enzymatic action.

Mr. Shipp: You made a very interesting statement regarding the possibility of destroying cotton fibers by mildew growth in a few hours. I presume that you have in mind *Chaetomium globosum*. If your idea of adding preformed enzymes to the culture of *Chaetomium* accelerates the destruction of the fiber to such an extent, there is an excellent opportunity to develop a quick acceptance test for mildewproofed fabric. The Government is making many millions of military sand bags now and the mildewproofing as in effect now requires seven days of incubation with *Chaetomium*. This causes plenty of delay in the acceptance procedure. Would it be possible at the present stage of your work to apply your idea to the development of a test procedure requiring only one or two days?

Mr. Marsh: Yes, it is possible. We have been conducting work of this nature. We know that the action of cellulose destruction is enzymatic, that is, a fermentation of the cellulose fiber. We believe that if we can isolate the proper cellulose decomposing enzyme we can add the proper amount of that enzyme to the fiber and measure the destructive effect.

Mr. Duvois: In the bacteriostatic tests, what would be the concentration of the germicide on the cloth?

Mr. Marsh: For this particular case the fabric was dipped in a 1 to 100 dilution. Other agents are active in dilutions up to 1 and 30,000.

Mr. Dannerth: Should the germicide be present in both the finished fabric and the fiber itself?

Mr. Marsh: It should be present in both.

Mr. Dannerth: In that concentration?

Mr. Marsh: Yes, it is difficult to apply a germicide to the finish alone and not to the fiber and gain any degree of permanency of mildew resistance or bacteriostasis. The finish may leach out.

Mr. Dannerth: It must be incorporated in the original?

Mr. Marsh: For the best results, it should be incorporated in the fiber and in the finish. Most finishes are highly contaminated and as said before provide excellent nutrition for bacterial growth. Therefore, it is best to incorporate the germicide in both finish and fiber.

Mr. Rogers: Would you consider the use of a germicide a very good thing in the prevention of mildew growth in a process such as the wet spinning of cotton tire cord, where the cords go through a solution of water and, in many cases, a wetting agent in addition, directly to the cone?

Mr. Marsh: Are you referring to any particular type of mildewproofing?

Mr. Rogers: No, I wasn't speaking of any particular type. They use quite a number of different wetting agents. For example, if they were using just ordinary city water in the conditioning trough, without any wetting agent at all, and in twisting, or combing, and then going direct to the cone, it seems to me that by winding the cord in that condition, the inside of the cone is going to remain wet for a considerable period of time. I was wondering if that would be a very desirable thing?

Mr. Marsh: Wet cones would lead to a mildew condition unless an effective germicide was used. If the wetting agents used possessed bactericidal properties they would be an aid in preventing mildew growth.

Mr. Rogers: From reports of mildew growth, we are led to believe that the wetting agent used can have slight bactericidal properties.

Mr. Marsh: Some do, especially those known as the quaternary ammonium compounds. Wettings agents effect bacterial growth by bringing about changes in surface tension.

Mr. Dannerth: Would you say that a cotton fiber which, let us assume, has eight per cent of moisture, is subject to decomposition even with that percentage of moisture.

Mr. Marsh: 15 per cent or even slightly less moisture may result in a mildew condition. Some mildew growth is visible and some is not. Textiles stored over a period of years are known to lose their tensile strength and become discolored. Some of this loss of tensile strength can be traced to the action of fiber decomposing organisms, even though the textile has not been used and is in a fairly dry condition.

Mr. Dannerth: That lets the bleacher out. (Laughter)

Mr. Marsh: Partly.

Mr. Brosnan: Do resins inhibit the growth of bacteria?

Mr. Marsh: Yes, to a certain extent. It all depends on

the chemical structure of the resin. The formaldehyde types exhibit bacteriostatic values.

Mr. Brosnan: I had an interesting experience in connection with wet spinning, where I carried on some wet spinning and instead of using water, I used a formaldehyde resin. After the yarn was spun and threaded, it was very strong as compared to the wet spun. Is it likely that that is possible?

Mr. Marsh: Yes that is possible. That fabric might have set around in a wet condition without a resin and in a few hours time lost part of its tensile strength, whereas the one that was resin treated might have prevented the growth of decomposing bacteria. Also the resin might have chemically reacted with the fiber to produce a stronger fiber.

Mr. Freedman: Have you had an opportunity to investigate the bacteriostatic, or, I would like to go a little bit further and say, the bactericidal effect of various volatile gases or substances?

Mr. Marsh: Might I ask just what gases you are referring to?

Mr. Freedman: Clear chloropicrin, for example.

Mr. Marsh: I believe some work has beeen done on the inhibitory effect of gases. Gases evidently possess no permanent germicidal properties because of their volatile nature. I doubt if you would be able to render a fabric bacteriostatic or bactericidal by the use of a gas. You are thinking possibly of formaldehyde.

Mr. Freedman: Yes, so far as formaldehyde is concerned, considerable research has been done with it and it appears to be effective only on the surface.

Mr. Marsh: Yes, that is true.

Mr. Freedman: It has little penetrating ability.

Mr. Marsh: The general practice is to treat goods with formaldehyde for storage or insect infested goods. Bales of fabrics or raw materials are placed in a gas chamber into which is introduced relatively large amounts of the gas. Whether or not the formaldehyde thoroughly penetrates the bales is a question. It is contended that bales so treated and then stored are protected against molds, mildew and bacteria. However, formaldehyde being very volatile and highly reactive I do not believe it to be too efficient a bactericidal agent.

Mr. Freedman: That has also been tried with bales of cotton, where the formaldehyde has been employed in a vacuum chamber. Even here the penetration has not been sufficient.

Mr. Marsh: That is interesting.

Mr. Freedman: Probably the action has not been satisfactory because of the inability to get moisture all the way through the bale.

Mr. Marsh: And possibly due to the chemical reactivity of formaldehyde with the fiber forming nonbactericidal compounds.

Mr. Freedman: Have you seen any fungi growing on any of the vinyl-like coated materials or vinyl-like sheet fabrics?

Mr. Marsh: No, as I have had very little experience with them. I have had some experience with coated fabrics such as mattress covers which may possess a high bacterial population.

We must regard bacteria in the textile world in the light that everything on earth goes back to earth, and everything no matter what it is, is continually subject to bacterial attack. The only difference in materials is that some are more difficult to destroy than others.

Mr. Freedman: Do you think it proper to refer to a fabric as mildewproof—let us use a shower curtain to be specific—when we only know that it appears to be mildewproof under laboratory conditions.

Mr. Marsh: Laboratory tests are accelerated conditions because of the time element. For efficient mildewproofing we must add enough of the particular agent so that under the conditions of use the curtain will remain bacteriostatic as long as possible.

Mr. Freedman: What effect, if any, has lead on the growth of mildew?

Mr. Marsh: Some organisms may thrive on a lead diet and others may be killed or weakened. It can be stated that the salts of heavy metals exert a bacteriostatic effect. This is particularly true of the silver, copper and mercury compounds. There is an interesting historical portrayal of this point. Thousands of years ago in India it was known that water kept in copper kettles did not spoil or turn bad whereas water kept in earthenware or other containers would be unpalatable. Most of the heavy metals are bactericidal.

Mr. Freedman: We had occasion to see a number of so called mildewproofed curtains that became very tender and gave evidence of being contaminated with mildew, particularly at the bottom and adjacent to the lead weight. This is the reason I asked that question.

Mr. Marsh: There are some organisms which grow in the presence of lead just as there are bacteria which will not grow without the presence of iron compounds.

Mr. Wolfe: Superimposed on that question of shower curtains, would there be any reaction from soap that gets on those curtains?

Mr. Marsh: Some organisms are stimulated and some inhibited by the presence of soap. Contrary to opinion soaps have very little if any, antiseptic properties outside of physical action.

Member: Thallium and thorium compounds are quite toxic as well as anything that approaches the radioactive elements. Are these types of compounds toxic to bacteria?

Mr. Marsh: I believe they are but because of high toxicity are too dangerous for general use.

Member: Would you have any explanation why cotton

duck, dyed with a vegetable dye like cutch, is more resistant to mildew than when it is dyed with a synthetic dye?

Mr. Marsh: No, unless it is in itself inhibitory or contains a specific chemical bactericide.

Chairman Tisdale: Can you tell us more about it?

Mr. Marsh: Unfortunately my knowledge of this compound is very limited. I only know that it has been in use for a considerable period of time. It certainly would be interesting to study its bactericidal properties.

Mr. Freedman: What effect has tannic acid on the growth of bacteria?

Mr. Marsh: Some molds thrive in its presence and others are rendered bacteriostatic or weakened.

Mr. Shipp: I understand that you said there is one compound which is toxic to mildew both in the dry state and in the wet state.

Mr. Marsh: And you want to know what that compound is?

Mr. Shipp: Well, if I may and you have it.

Mr. Marsh: Let me explain our position on that point. We are carrying on work for various clients. Having their confidence we cannot release such information unless with their authorization. However, if you are interested in discussing your particular problem with us we will be glad to investigate the possibilities of this germicide for your particular bactericidal condition.

Mr. Shipp: My question was dictated by something else and more general in scope. I have tried to digest the statement regarding toxicity in the dried state and I still cannot understand it. My understanding is that mildew grows only in humid conditions. It is also generally assumed that there is no toxic material which would be active without being at least slightly soluble. In fact, all the so called "insoluble" chemicals used as poisons in fungicidal and insecticidal preparations, antifouling shipbottom paints, and so forth, for instance, copper napthenate, copper oxide, arsenic and mercury compounds, are soluble to a slight extent. These infinitesimally small quantities of dissolved chemicals act as poisons in the digestive system of the pest, fungus and so forth. If you say that your material is effective in the dry state, well, I cannot understand the mechanism of its action.

Mr. Marsh: Neither do I, except I know that if viable dried organisms are placed in contact with a fabric so treated in the absence of moisture that all of the organisms removed, without the aid of water, are killed. This indicates that moisture is not necessary to kill organisms coming in contact with this compound. As you know, most bactericides must be at least slightly ionized to be efficient.

Mr. Duvois: Is this product water soluble?

Mr. Marsh: As it is sold it is water soluble and soluble in organic reagents except benzene.

Mr. Duvois: Does it leach out?

Mr. Marsh: Properly applied it withstands washings and dry cleanings.

Mr. Freedman: Is this product insecticidal?

Mr. Marsh: No, it is not.

Mr. Duvois: Does it withstand the rotproofing test, the burial tests?

Mr. Marsh: The burial test is now being conducted with it.

Mr. Duvois: Against which organisms is it active?

Mr. Marsh: It appears to be active against both gram positive and gram negative organisms, pathogenic and nonpathogenic with varying degrees of activity. It will kill *staphylococcus* in less than one minute in high dilutions.

Mr. Freedman: What is the phenol coefficient?

Mr. Marsh: The phenol coefficient is 15.

Mr. Duvois: What does the phenol coefficient mean and what is the value of bacteriostasis of cloth?

Mr. Marsh: That is a very good question. Both of these are merely a way of measuring. Lord Kelvin said that there is no sense knowing anything about anything unless you can measure some part of it. Only then can you record values. However, the phenol coefficient determination is limited in that it is not applicable to all types of germicides.

UNEMPLOYMENT REGISTER

Members of this association, who are without employment, should forward to the secretary a statement as to their qualifications and experience. This information will subsequently appear on these pages with an identifying key number. Employers are also requested to file with the American Dyestuff Reporter any vacancies which may occur in their business.—H. C. Chapin, Secretary, Lowell Textile Institute, Lowell, Mass.

NOTICE TO EMPLOYERS

Personal Histories and Employment Records of the following applicants are on file at the office of the American Dyestuff Reporter. Prospective employers may examine them without obligation.

Key: A—Laboratory and research; B—Dyeing or printing; C—Finishing; D—Sales; E—Instruction; F—Executive.

NOTE: PERSONS WHO HAVE OBTAINED EMPLOYMENT SHOULD NOTIFY THE SECRETARY OR THE AMERICAN DYESTUFF REPORTER AT ONCE.

A-3

Education—B.S. in chemistry, Lehigh University.

Experience—Experimental engineer and analytical chemist, 8 mos.; assistant superintendent of silk corporation, assisted in planning and directing production, in charge of laboratory, technical work, personnel, purchasing, etc., 2 years; inspector of ordnance material, to the present. Seeks position as chemical engineer or chemist.

Age 25; single; references.

A-B-18

Education—Graduate Philadelphia Textile School, 1940.

Experience—Has experience as assistant chemist and trouble shooter in silk dyeing and finishing plant; as manager of laundry store; and as printer and colorist in screen printing plant. Seeks position in laboratory and research, dyeing, printing or finishing.

Age 21; single; references.

A-B-C-F-3

Experience—Broad experience since 1906 as overseer of finishing, general researcher, trouble shooter, overseer of dyeing, general superintendent, mill manager. Experienced in woolen, worsted, cottons, unions and mixtures. Recently specialized in men's wear cottons. Seeks position as overseer of finishing or dyeing, assistant superintendent, superintendent or manager.

Age 53, married; references.

B-10

Education—2 years chemistry, 2 years textile chemistry and dyeing, Lowell Textile Institute, evenings.

Experience—4½ years dyeing and bleaching hosiery, specializing in children's and infants' hose; 3 years assistant dyer, dyeing and bleaching cotton, mercerized and unmercerized, wool, wool-cotton, wool-rayon and wool-silk hose. Seeks position as second hand, assistant dyer or laboratory assistant in hosiery mill.

Age 27; single; references.

B-D-1

Education—High school graduate; textile chemistry, Textile Evening High School, New York City; accounting; typist.

Experience—from 1935 to present employed as colorist with screen printing plant in New York City. Experienced with all types of fibers and all types of dyes. Shade matching. Versed in accounting, typing, modern office procedure and sales promotion. Able assistant to busy executive. Age 46; single; references.

C-1

Experience—Experienced as assistant finisher, finisher and superintendent of finishing since 1923. Experience on automobile cloth, boucle overcoatings, high grade men's wear worsted, low grade woolens, medium grade plaid-back overcoatings, fleece finish overcoatings, Bolivias, kerseys, medium-grade men's piece dye suitings, uniform cloth, flannels, ladies' dress goods and coatings, government serge and elastique fabrics, marine wool, flannel shirtings.

Age 37; married, 3 children; references.

Discussion of CONSERVATION ORDER M — 103*

ARNOLD L. LIPPERT

Chief, Dyestuff Section, Textile, Clothing and Leather Division, War Production Board

IN these days when we hear of planes, tanks, ships and guns, we are apt to overlook the importance of organic coloring materials in our war effort. The succeeding months of the year 1942 have seen an ever-increasing production of military dyes by the American Dyestuffs Industry and a decreasing production of civilian dyes. Today civilian dye production only represents a small percentage of the total on an industry-wide basis. The demands of the armed services have been very great yet the industry has been able to successfully meet every military demand which has been placed upon it even though some regulation has been necessary.

It is a well known fact to everyone in the audience that the American Dyestuffs Industry was born of World War I. What is less well known is the progress which has been made since World War I. The dyestuff production in 1917, the first year of our participation in the war, was 46,000,000 lbs. The production in 1941 was 168,000,000 lbs., nearly four times as large. Even more striking is the production of vat colors other than indigo which was 14,000 lbs. in 1917 and in 1941, 27,000,000 lbs., an increase of about 2,000 fold. It is also interesting to note that the production of Sulfur colors in 1918 was greater than any year up to 1941 because a large volume of the fabrics in World War I were sulfur dyed.

While the use of dyes to achieve durability and protective coloration was widespread in World War I, the developments and technique of the current conflict have made imperative a tremendous increase in the use of organic coloring materials not only as a protective dye for textile articles, but also as a method of camouflage on other materials and as a means of communication and identification of many other materials and specific actions. We realize the importance of protective coloration when we read of the green-clad Japanese creeping through the jungles of the Southwest Pacific. We realize the importance of textiles when we study the winter campaigns in Russia. The developments in aerial observation and photography have given a new importance to organic coloring materials.

The developments of the American Dyestuff Industry since World War I have stood us in good stead in meeting the demands which this war has placed upon it. Our armed services have been getting the best dyes made anywhere in the world and in sufficient quantity. The conversion of the industry from peacetime economy to fulfill wartime needs has not been easy. The use by the military forces of only a few of the many civilian shades and the extreme emphasis on Anthraquinone Vat colors has meant the maximum conversion of facilities and wide use of subcontracting. We would like to take this opportunity to state that the efforts and cooperation of the American Dyestuffs Industry has been of the highest possible degree and this effort has been largely responsible for the success achieved. Those dyestuff manufacturers who had made and were making anthraquinone vat colors have been especially helpful.

In World War I the Dyestuff Industry had only few competitors for aromatic chemicals which serve as basic raw materials for the manufacture of dyes. How different is the problem today where many extremely vital military products are all competing for the same materials. The amount of basic chemicals going into the manufacture of explosives, pharmaceuticals, aviation gasoline, synthetic rubber, are unusually large. The dyestuff industry must share the supplies of raw materials with these other vital uses.

The tremendous demand of the armed services for a relatively small number of dyes created a situation early in 1942 which led to specific action by the War Production Board. This action was the issuance on March 28 of Conservation Order M-103, amended on May 26, June 26, and September 30. The two basic reasons for the issuance of this order were that the supplies of certain finished dyes were insufficient for both military and civilian and that there was a shortage of anhydrous aluminum chloride which is necessary for the manufacture of anthraquinone derivatives.

This conservation order is predicated on several basic principles. Before discussing these principles, it might be well to mention that a return of excess inventory of list A dyes was included in the original order and not repeated. By this provision alone a one and a half month's supply of thse dyes was made available for military procurement not counting new production.

The first basic principle upon which Conservation Order M-103 is based is the setting aside of certain specific dyes for military use only. Obviously all the dyes which are used for military purposes, or even those the major percentage of which are used for military purposes, may not

*Presented at meeting, New York Section, November 6, 1942.

necessarily be included. List A includes those dyes the entire production of which is needed for military purposes. This list may be expanded or contracted as the need arises. Already one change has been made.

The second basic principle of Conservation Order M-103 is the establishment of civilian quotas on the anthraquinone vat dyes not restricted for military use and on other anthraquinone dyes which include the alizarine and acetate colors. A quota has been placed upon the manufacturer or seller based on past sales. A quota has been placed on consumer, not only from the standpoint of a percentage of past purchases, but also in addition a percent quota on use based on past use. These quotas are set quarterly with the year 1941 as the base period. Unused portions of the quota may not be carried over to a succeeding quarter. These quotas cover the sum total of dyes within a class and not each individual dyestuff.

There are many ways to achieve regulation and control over materials so that they are directed in the proper channels and conservation is affected. With specific reference to dyes it could be achieved by limiting and eliminating certain specific dyestuffs. It could be brought about by limiting and eliminating certain specific uses of dyes. The attainment of these ends would mean the regulation of several thousand products multiplied by several thousand end uses covering a dozen industries. All of these results are obtained by setting a quota over the sale, delivery and use of dyestuffs. This principle is also predicated on the belief that men in an industry know most about that particular industry. This allows the full play of ingenuity and allows industry to run its own business. If a consuming mill is limited to his use of dyes, it is forced to conserve and to extend the use of dyes as much as possible.

These quotas are set quarterly. They are determined primarily by the supply of raw material which is available for the manufacture of dyestuffs. They are determined secondarily by the demands of the military and the civilian needs. We should like to be able to set the quota for longer periods. This, however, cannot be done since the supplies of raw material change from month to month. However, since a quarterly basis is the shortest possible period during which production can be efficiently planned, we have chosen that period. Thus the quotas are revised quarterly.

With other limitations which have existed concurrently, we believe that the restrictions under Conservation Order M-103 have not been too severe. However, past performance has given no assurance of the future. We have largely neglected seasonal trends and fluctuating demands because we have not discovered a simple formula for integrating these trends with the other factors involved. Furthermore, the seasonal trends cut across each other and do not apply to any class of dyes as a whole.

We have separated the anthraquinone vat dyes from other anthraquinone colors because of the divergence of end uses and in anticipation of a future necessity whereby the quota applying to these two groups might not necessarily be the same.

Before we leave the question of civilian dye quotas, I should like to clear up the misinformation and misinterpretation which has been present in some newspapers and magazines and, I understand it has even been in advertisements over the radio. This misinformation is that war dyes and textiles dyed from war dyes possess unsatisfactory performance and fastness qualities therefore extreme caution should be used in purchasing, laundering and dry cleaning these war textiles which are processed with war dyes. This information is entirely incorrect. To our knowledge all of the high quality dyes with the exception of those 9 restricted by list "A" of M-103 have been available in sufficient quantities to meet all civilian demand with very few exceptions. Even those list "A" dyes which have been restricted may be substituted by other materials which give entirely satisfactory high quality performance for civilian work. There is no reason why war textiles should not possess the desirable characteristics of those materials which have been processed in peace time. We have endeavored by the policy of true conservation to make available these dyes of high quality and performance to meet civilian demands because existence of these high quality materials will insure a saving of textile materials, dyes, chemicals from which the dyes are made, as well as being an outstanding economic advantage to the civilian consumer.

The third basic principle of Conservation Order M-103 is the establishment of export quotas. These apply to those friendly countries which no longer are able to obtain their supplies of dyestuffs from Europe and are dependent upon the United States. These quotas were set up after a study of past shipments and potential demands. Unlike the domestic civilian quotas which are based on past use, the export quotas are based on production. In other words, if American dyestuffs production is large, a larger share is made available for export and conversely, if the production should decrease for some reason, the amount available for export is correspondingly smaller. We believe that these export quotas reflect approximately equal treatment of the allied nations' civilian population with our own civilians.

These nations also are supporting armed forces some of which are actively engaged. Here again we have made available, based on an export quota, an amount of list A or military dyes based on production so that these countries again share our increases or decreases in production. These quotas may also be revised quarterly depending upon conditions.

The fourth general principle of Conservation Order M-103 is the provision that in addition to specific military uses, certain others are exempt. These are free sale between dyestuff manufacturers, quantities for experimentation, and use in leaded gasolene. It might be well to elaborate further on the provisions relating to experimental use since

I believe this provision has been subject to some misinterpretation. Experimental use means no past use of the specific dyestuff within a reasonable time. Once the twenty-five pounds of any color is used, additional quantities are no longer considered experimental. This holds indefinitely.

The fifth and last principle of Conservation Order M-103 is the absolute prohibition which now is illustrated by the provisions relating to Meta Toluylene Diamine and Anthraquinone. In these cases we believe the uses are unnecessarily wasteful and should be eliminated, the secondary factor being the existence of substitutes. There are no exceptions to these provisions.

I have dwelt with considerable detail on the provisions of Conservation Order M-103 which may have seemed academic to many who have followed the dyestuffs regulation. However, in closing I wish to emphasize that it is important to view Conservation Order M-103 in the proper perspective not only as an instrument whereby the anthraquinone dyes regulation is attained, but also more important as illustrative of the broad principles which we may prefer to use as a basis for future action with respect to other organic coloring materials.

NOTE—The discussion which followed Dr. Lippert's address will be published in the near future.—ED.

MEMBERSHIP

APPLICATION BLANKS

for individual

and corporate

MEMBERSHIP

may be obtained

from the Secretary of the Association

DR. H. C. CHAPIN

Lowell Textile Institute, Lowell, Mass.

CALENDAR OF COMING EVENTS

Meeting, Rhode Island Section, November 27, 1942, Providence Engineering Society, Providence, R. I. Subject: Open Forum on "The Employment of Women in the Textile Industry to Replace Men Who are in the Armed Services." Speakers: H. V. King, chairman, "Introductory Remarks"; Carl Meddes, Lorraine Mfg. Co., "Worsted Division"; Charles Sedgwick, Esmond Mills, "Woolen Division; Elliot Broadbent, Glenlyon Print Works, "Cotton Piece Goods Division"; Thomas Goulet, Woodlawn Finishing Co., "Cotton Yarns Division"; Wm. D. Fales, Rhode Island School of Design, "The Present Training of Women."

Meeting, New York Section, December 4, 1942, Downtown Athletic Club, New York City. Subject: "Dyeing Piece Goods for the Navy." Speakers: Lt. Cmdr. W. F. Prien, U. S. N., "General Requirements and Specifications"; Roland Derby, The Derby Co., "Piece Goods Dyeing with Leuco Ester of Indigo"; George Linberg, E. I. du Pont de Nemours & Co., Inc., "Continuous Piece Goods Indigo Dyeing Process.

Meeting, Philadelphia Section, December 4, 1942.

Meeting, Northern New England Section, January 15, 1943.

Council and Research Committee Meetings, January 16, 1943, Boston, Mass.

General Business Meeting (in conjunction with New York Section meeting) April 16, 1943, New York City.

Council and Research Committee Meetings, April 17, 1943, New York City.

THE NITROPARAFFINS

and Their Derivatives

*Their Use in the Chemical Processing of Textiles**

HILLARY ROBINETTE
Commercial Solvents Corp.

THE nitroparaffins and the derivatives of the nitroparaffins constitute a new group of chemicals that have become commercially available through the combined efforts of the Purdue Research Foundation and Commercial Solvents Corporation.

Ten years ago Professor Henry B. Hass of Purdue University started to make nitroparaffins by the direct nitration of paraffin hydrocarbons with nitric acid. By 1935 the work had progressed to the stage where the process looked commercially feasible. It was at this time that Commercial Solvents Corporation arranged with the Purdue Research Foundation an exclusive license agreement so that the commercial possibilities of the nitroparaffins might be developed. Research work was, for the most part, transferred to the laboratories of the corporation; and the C. S. C., Research and Development Staff, after about five years of effort, made the nitroparaffins and a number of their derivatives commercially available. A plant was built at Peoria and commercial production of several of the nitroparaffins and their derivatives was started in May of 1940.

Four nitroparaffins are being produced and these are starting materials for several hundred derivatives. As these derivatives became available from the plant and research laboratories, they were evaluated in the various Service Laboratories maintained by Commercial Solvents Corporation in Terre Haute. These are the Lacquer, Emulsion, Rubber and Textile Laboratories.

The Textile Service Laboratory has evaluated a large number of these derivatives for use in such varied applications as in wetting agents, scouring agents, mercerizing assistants, degumming agents, cation-active finishing agents, kier-boiling assistants and lubricating emulsions.

The following diagram shows the synthesis of these nitroparaffins:

THE REACTION OF PROPANE, A TYPICAL PARAFFIN HYDROCARBON, WITH NITRIC ACID

$$CH_3CH_2CH_3 + HNO_3 \longrightarrow \begin{matrix} CH_3NO_2 \\ C_2H_5NO_2 \\ CH_3CHNO_2CH_3 \\ CH_3CH_2CH_2NO_2 \end{matrix}$$

It can be seen that nitrating propane gives four nitroparaffins: nitromethane, nitroethane, 1-nitropropane, and 2-nitropropane.

Table I gives the physical constants of the nitroparaffins.

USES OF NITROPARAFFINS

Solvents for cellulose acetate, cellulose triacetate, cellulose acetobutyrate, vinyl resins, nitrocellulose, synthetic resins, dyes, oils, fats, waxes, and many organic materials. Intermediates in the synthesis of organic compounds including rubber chemicals, emulsifying agents, pharmaceuticals, dyestuffs, photographic chemicals, insecticides, larvicides, wetting agents, textile chemicals.

*Presented at meeting, Northern New England Section, February 27, 1942.

TABLE I

	Nitromethane	*Nitroethane*	*1-Nitropropane*	*2-Nitropropane*
Formula	CH_3NO_2	$CH_3CH_2NO_2$	$CH_3CH_2CH_2NO_2$	$CH_3CHNO_2CH_3$
Molecular Weight	61.04	75.07	89.09	89.09
Specific Gravity at $\frac{20°}{20°}$ C	1.139	1.052	1.003	0.992
Pounds Per U. S. Gallon at 20° C	9.48	8.75	8.35	8.24
Melting Point, °C	—29	—90	—108	—93
Boiling Point, °C	101.2	114.0	131.6	120.3
Flash Point, °F (Tag open cup)	112	106	120	103
Vapor Pressure, mm at 20° C	27.8	15.6	7.5	12.9
Surface Tension, dynes per cm at 20° C	37.0	31.3	30.0	30.0
Refractive Index at 20° C	1.3818	1.3916	1.4015	1.3941
pH 0.01M Aqueous Solution at 25° C	6.4	6.0	6.0	6.2
Rate of Evaporation, by wt. (n—Butyl Acetate=100	180	145	100	124
Solubility at 20° C				
ml Solvent in 100 ml Water	9.5	4.5	1.4	1.7
ml Water in 100 ml Solvent	2.2	0.9	0.5	0.6

These nitroparaffins find some application in the textile-chemical field, where they are used as solvents. The nitroparaffins have excellent solvent action on some of the more difficultly soluble substances and can be used in preparing lacquers containing nitrocellulose, cellulose acetate, Vinylite, cellulose acetobutyrate, and other similar film-forming materials. These lacquers are extensively used in one branch of the textile industry—the coated fabric or imitation leather industry. Emulsions of these film-forming materials and other resins soluble in the nitroparaffins find use in the preparation of pigment-printing binders and resin finishes.

The following table shows the wide range of substances soluble in 1- and 2-nitropropane:

TABLE II

Waxes	Rezyl 19
Bayberry	Rezyl 114 (SS)
Ceresine (SS)	Santolite MH
Japan (SS)	Santolite MHP
Spermaceti (SS)	Teglac 65
Natural Resins and Gums	Uformite
Barbados Manjak No. 84 (SS)	Vinylite H
Cumar	Vinylite HH-44 (SS)
Dammar (PS)	*Dyes*
Dammar (de-waxes) (SA)	Oil-soluble
Kauri white (SA)	Spirit-soluble (SS)
Manila (SA)	*Organic Chemicals*
Pontianak (SA)	Acetic acid
Rosin (SS)	Acetone
Tars and Pitches	Aniline
Blown asphalt (SS)	Benzol
Bone pitch (SS)	Butanol
Gilsonite (SS)	Butyl acetate
Petroleum asphalt (SS)	Butyl butyrate
Refined coal tar (SS)	Butyl lactate
Road tar	Butyl propionate
Coating Materials	Butyric acid
Benzyl cellulose	Cottonseed oil fatty acids
Cellulose acetate (SA)	Dibutyl phthalate
Cellulose acetobutyrate	Ethyl alcohol
Cellulose acetopropionate	Ethyl acetate
Chlorinated rubber	Ethyl ether
Ethyl cellulose	α-Ethyl-β-propyl acrolein
Nitrocellulose	Isopropyl alcohol
Synthetic Resins	Maleic anhydride
Arochlor 1242	Mesityl oxide
Arochlor 4465 (PS)	Naphtha, aliphatic
Bakelite BR-8900	Naphthalene
Bakelite XR-3180	Phenol
Bakelite XR-9366	Phthalic anhydride
Beckacite 1001	Picric acid
Beckacite 1100	Ricinoleic acid
Beckacite 1110	Toluol
Beckacite 1112	Tributyl phosphate
Durez 500	Zinc stearate
Durez 525	*Oils and Fats*
Durez 550	Castor oil
Ester gum	Cocoanut oil
Glyptal 2471	Lanolin (SS)
Mowalith N	Linseed oil
Paraplex 5B	Petroleum ether
Paraplex RG2	Petroleum oil
Pliaflex	Soya bean oil
Rezyl 14	Tung oil

Key:
SA—soluble in the presence of alcohols
SS—soluble but less than 10 g/100 ml
PS—heterogeneous material; only part of it soluble

Note:
All unkeyed substances soluble to the extent of at least 10 g/100 ml.

One of the more important reactions of the nitroparaffins is the reaction between the nitroparaffins and aldehydes in the presence of basic catalysts to form nitrohydroxy compounds having one, two or three hydroxyl groups, depending upon the nitroparaffin used. The following example illustrates this reaction:

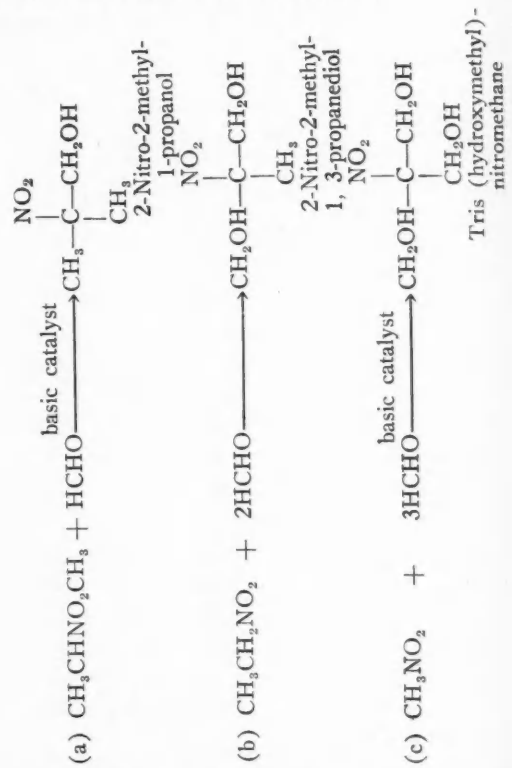


Table III shows the physical properties of the nitrohydroxy compounds.

USES OF NITROHYDROXY COMPOUNDS

Heat sensitizers for rubber latex, zein solvents, mild oxidizing agents; intermediates in the synthesis of emulsifying agents, high-boiling solvents and plasticizers, surface-active agents, and flotation agents.

These nitrohydroxy compounds have been found useful as softening and finishing agents for textiles (U. S. P. 2,231,458). Because they are mild oxidizing agents, they have been suggested for use in printing pastes, kier assistants, and dye baths; the polyhydric alcohols are especially useful in these applications.

An extremely interesting group of aminohydroxy compounds is being made by reduction of the nitrohydroxy compounds listed in Table III. These compounds offer great promise in textile-chemical applications, where, in addition to being useful as their simple soaps, they are starting materials for more complex textile specialties. Five aminohydroxy compounds are now being offered.

The following chart (Table IV) gives the physical properties of the aminohydroxy compounds.

TABLE III
Nitrohydroxy Derivatives
Properties of Pure Materials

	2-Nitro-1-butanol	2-Nitro-2-methyl-1-propanol	2-Nitro-2-methyl-1, 3-propanediol	2-Nitro-2-ethyl-1, 3-propanediol	Tris (hydroxymethyl)-Nitromethane
Formula	$CH_3CH_2\underset{\displaystyle NO_2}{\underset{\vert}{C}}HCH_2OH$	$CH_3\underset{\displaystyle CH_3}{\underset{\vert}{\overset{\displaystyle NO_2}{\overset{\vert}{C}}}}CH_2OH$	$CH_2OH\underset{\displaystyle CH_3}{\underset{\vert}{\overset{\displaystyle NO_2}{\overset{\vert}{C}}}}CH_2OH$	$CH_2OH\underset{\displaystyle C_2H_5}{\underset{\vert}{\overset{\displaystyle NO_2}{\overset{\vert}{C}}}}CH_2OH$	$CH_2OH\underset{\displaystyle CH_2OH}{\underset{\vert}{\overset{\displaystyle NO_2}{\overset{\vert}{C}}}}CH_2OH$
Molecular Weight	119.12	119.12	135.12	149.15	151.12
Melting Point, °C	—47 to —48	90 to 91	147 to 149	56 to 57	165 to 170
Boiling Point at 10 mm, °C	105	94.5 to 95.5	Decomposes	Decomposes	Decomposes
pH of 0.1M Aqueous Solution at 20° C	4.5	5.1	5.4	5.5	5.6
Solubility in Water-grams per 100 ml at 20° C	20	350	80	400	220

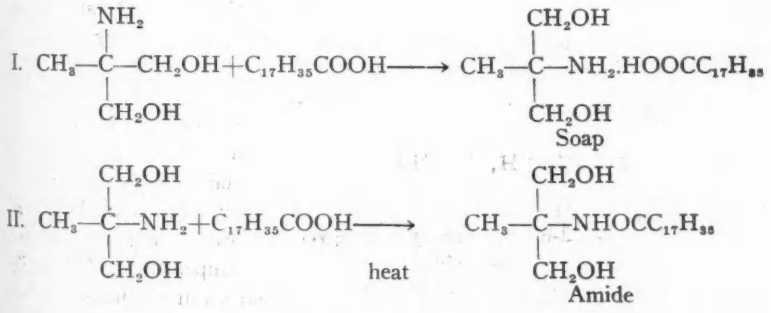
TABLE IV
Aminohydroxy Derivatives
Properties of Pure Materials

	2-Amino-1-butanol	2-Amino-2-methyl-1-propanol	2-Amino-2-methyl-1, 3-propanediol	2-Amino-2-ethyl-1, 3-propanediol	Tris (hydroxymethyl)-aminomethane
Formula	$CH_3CH_2\underset{\displaystyle NH_2}{\underset{\vert}{C}}HCH_2OH$	$CH_3\underset{\displaystyle CH_3}{\underset{\vert}{\overset{\displaystyle NH_2}{\overset{\vert}{C}}}}CH_2OH$	$CH_2OH\underset{\displaystyle CH_3}{\underset{\vert}{\overset{\displaystyle NH_2}{\overset{\vert}{C}}}}CH_2OH$	$CH_2OH\underset{\displaystyle C_2H_5}{\underset{\vert}{\overset{\displaystyle NH_2}{\overset{\vert}{C}}}}CH_2OH$	$CH_2OH\underset{\displaystyle CH_2OH}{\underset{\vert}{\overset{\displaystyle NH_2}{\overset{\vert}{C}}}}CH_2OH$
Molecular Weight	89.14	89.14	105.14	119.16	121.14
Melting Point, ° C	—2	30 to 31	109 to 111	37.5 to 38.5	171 to 172
Boiling Point, °C	178 (760mm)	165 (760mm)	151 to 152 (10mm)	152 to 153 (10mm)	219 to 220 (10mm)
Specific Gravity at $\frac{20°}{20°}$ C	0.944	0.934	....	1.099	....
pH of 0.1M Aqueous Solution at 20° C	11.1	11.3	10.8	10.8	10.4
Solubility in Water—grams per 100 ml at 20° C	Completely Miscible	Completely Miscible	250	Completely Miscible	80

USES OF AMINOHYDROXY COMPOUNDS

Emulsifying agents for cosmetic creams and lotions, mineral-oil and paraffin-wax emulsions, leather dressings, textile specialties, polishes, cleaning compounds, "soluble oils"; intermediates in the synthesis of surface-active agents, vulcanization accelerators, pharmaceuticals.

The following diagram shows the reaction of the aminohydroxy compounds with stearic acid.



The soaps made from the aminohydroxy compounds (see Reaction I) find wide use in the textile-chemical and textile industries.

Anhydrous soaps can readily be made by combining a fatty acid with the aminohydroxy compounds. This cannot be done with the inorganic bases or with ammonia. For a given aminohydroxy compound, the organic soap varies in consistency depending upon the fatty acid used. The laurates and oleates are liquids, whereas the stearates are solids. The soaps, in addition to being readily soluble in water, are soluble in a wide variety of organic liquids such as alcohols, benzene, naphtha, pine oil. Alcohols, glycol, glycerol, and ketones are excellent solvents for these soaps.

These soaps are excellent scouring agents for textiles. Their water solutions are only mildly alkaline and on hydrolysis do not become strongly alkaline. They are useful for wool scouring, and for scouring of rayon, pile fabrics, etc. Of course, their resistance to acids and hard water is not much better than the simple alkali-metal soaps.

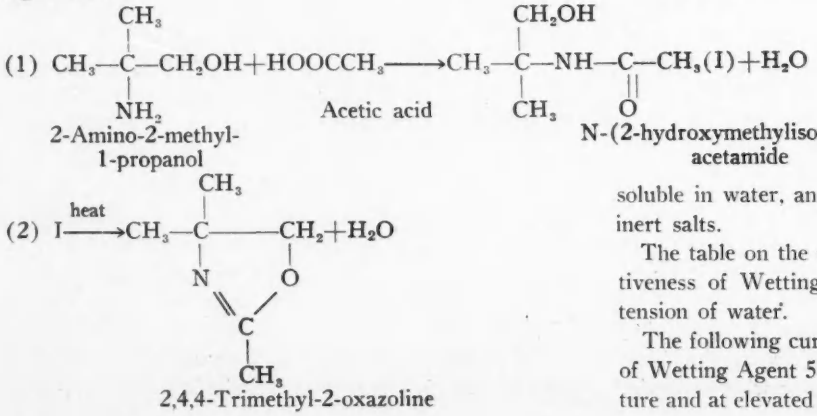
One very important use of the aminohydroxy soaps is in the preparation of the various emulsions used in textile processing. These aminohydroxy soaps are very powerful and effective emulsifying agents for most oils, fats, waxes, and resins that are normally used in textile processing. Both oil-in-water and water-in-oil emulsions can be prepared by selecting the proper aminohydroxy soap and

using it in the proper proportions. Self-emulsifying oils for raw-stock oiling can readily be prepared by dissolving in the oils and fats used, i.e., olive oil, lard oil, palm oil, tallow, mineral oil, etc., a small amount of the amino-hydroxy soap. Usually less than 10 per cent of the soap is necessary. The soluble oil may be used in this form for application to raw stock, or the soluble oil may be diluted with water to form an emulsion for use in yarn lubrication. The aminohydroxy soaps are useful in dry cleaning, where the use of the soap permits the incorporation of small amounts of water into the dry-cleaning bath, and thereby facilitates the removal of water-borne stains. Another interesting use of the aminohydroxy soaps is in lubricants for textile machinery. The addition of 0.1 to 2 per cent of an aminohydroxy soap to a good lubricating oil will effectively thicken it so that it will not run or drip. Naturally, an oil of this nature is desirable for use on textile machinery, since its use will prevent much damage due to oil spotting.

The hydroxy amides, an important class of chemicals made by heating the soaps of the aminohydroxy compounds, are of great interest as textile chemicals. Most of the hydroxy amides made from long-chain fatty acids and aminohydroxy compounds are solids with wax-like properties. They are dispersible in water and exhibit unusual surface activity. In addition to being surface-active, they contribute softness to most fabrics. Boil-off assistants for rayon and silk may be readily made from certain hydroxy amides. Kier-boiling assistants have also been prepared from the hydroxy amides. One interesting property of certain hydroxy amides is their ability to function as an efficient surface- and interfacial-tension reducer at elevated temperatures—even at the boiling point of water. This property makes these materials extremely useful as degumming agents for silk and as kier assistants for cotton.

Other reaction products of the aminohydroxy compounds and fatty acids, such as ester-amides and ester-amines, are synthetic detergents useful as wetting and scouring agents, resistant to hard water and to acid.

Substituted oxazolines may be made from the amino-hydroxy compounds and fatty acids according to the following reactions:



These compounds also have surface-active properties and are the starting point for the synthesis of acid-soluble soap-like materials useful for scouring and carbonizing wool, for cleaning metals, for emulsifying oils and waxes in the presence of acid, and for the preparation of cation-active softening and finishing agents.

A number of textile specialties have been developed by Commercial Solvents from the nitroparaffin derivatives, and are now being released to the textile industry.

Aminine S is a new cation-active finishing agent that imparts a soft, mellow hand to textile fabrics. It is a light-cream-colored paste, completely soluble in water. Aminine S is recommended for finishing cotton and rayon fabrics, and also for finishing leather. It can be applied under acid, neutral, or alkaline conditions, but it is more effective when applied in acid or neutral baths. It may be applied in a print washer, jig, dye bath, or starch mangle.

Aminine S is stable toward oxidation and will not turn rancid. Aminine S is compatible with soap, but is adversely affected by it; therefore, any fabric or material to which Aminine S is to be applied should be rinsed free of soap.

Aminine S does not affect the light fastness of most dyes, and it will not yellow white goods.

Aminine S sets direct dyestuffs and may be used in after-treating and in print-washing to prevent mark-off. Aminine S does change the shade of some dyestuffs; and in shade matching, it is sometimes necessary to make slight changes in the dyestuff formula to allow for the change of shade due to treatment with Aminine S.

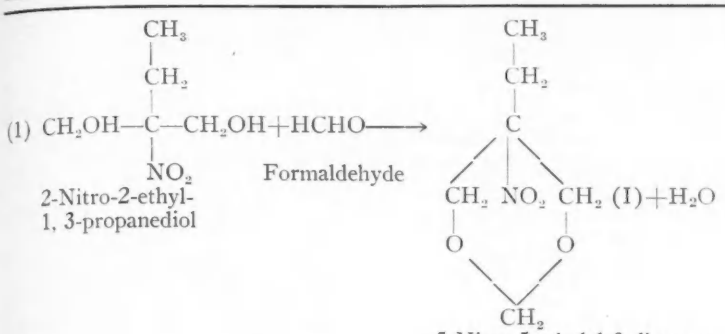
The amino dioxanes, a group of very active wetting agents, are prepared by condensing a nitro glycol with an aldehyde and subsequently reducing the nitro group of the nitro dioxane. The synthesis of such compounds is illustrated by the reactions shown at top of the next page.

Some of the amino dioxanes are very efficient wetting agents but because of their limited solubility it is necessary to combine them with a solubilizing agent such as a sulfonated castor oil or soap. With some substances, one gram per liter will cause instantaneous wetting of cotton yarn in the Draves Test.

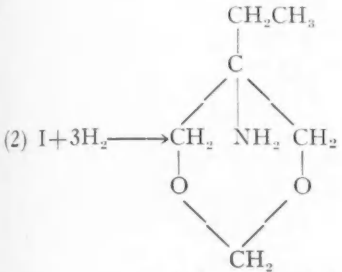
Wetting Agent 5-21 is a product made from the amino dioxanes. It is stable in the presence of mild acids, alkalies, hard water, and at elevated temperatures. It is easily soluble in water, and contains no sodium sulfate or other inert salts.

The table on the next page indicates the extreme effectiveness of Wetting Agent 5-21 in reducing the surface tension of water.

The following curves (Fig. 1) show the wetting activity of Wetting Agent 5-21 in distilled water at room temperature and at elevated temperatures, in extremely hard water.



Synthesis of amino dioxane

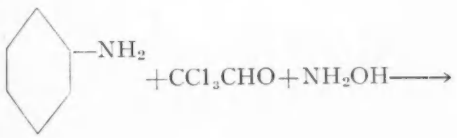


Surface Tensions of Various Concentrations of Wetting Agent 5-21 in Distilled Water as Determined with the Du Nouy Tensiometer

Concentration %	*Surface Tension dynes/cm*
1.0	32
.6	32.5
.2	33
.1	33.5
.05	34.5
.025	35.5
.012	38
.000	76

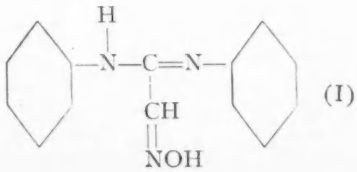
in acid, and in alkali. It can readily be seen that Wetting Agent 5-21 is an extremely efficient wetting agent for use under the varied conditions encountered in the wet processing of textiles.

Even indigo can be prepared with the aid of a nitroparaffin derivative. Hydroxylamine, which is made from primary nitroparaffins, is one of the starting materials in this synthesis:



(1)

Aniline



(I)

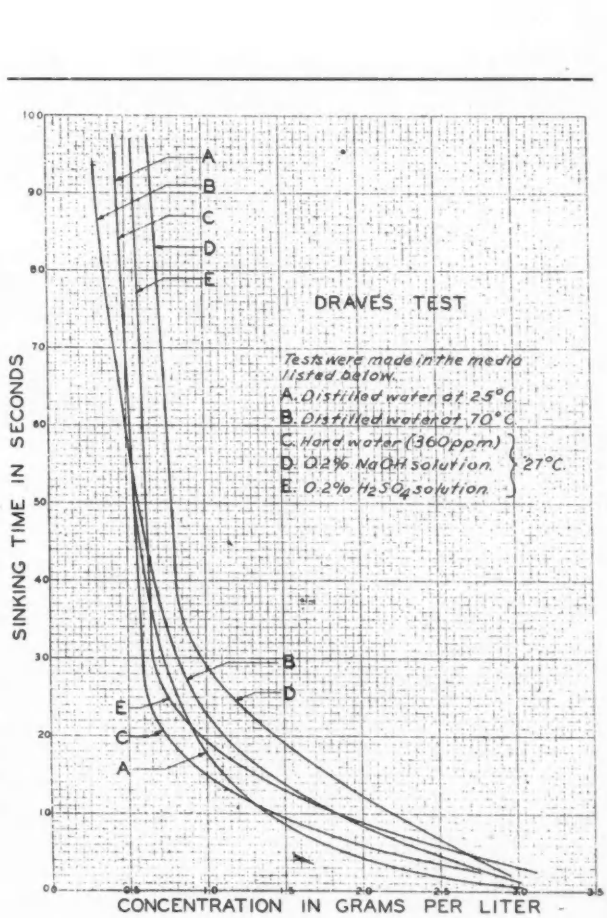
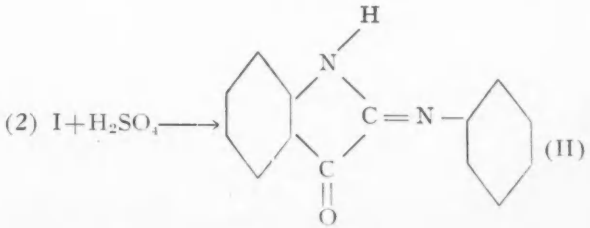
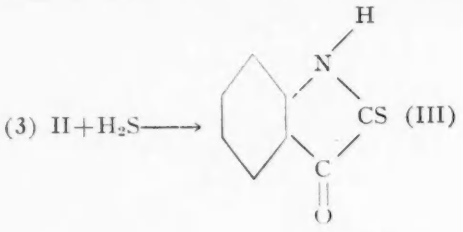
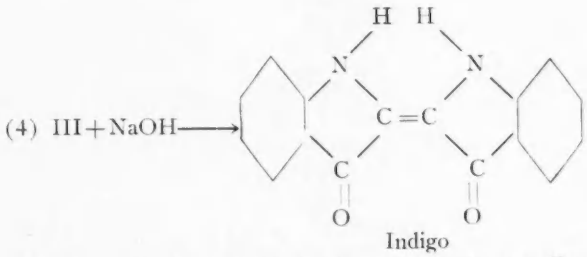

DRAVES TEST
Tests were made in the media listed below.
A. Distilled water at 25°C
B. Distilled water at 70°C
C. Hard water (360 ppm)
D. 0.2% NaOH solution
E. 0.2% H2SO4 solution
27°C.
SINKING TIME IN SECONDS
CONCENTRATION IN GRAMS PER LITER

Fig. 1



(II)





Indigo

Since over a thousand derivatives of the nitroparaffins have already been prepared, it would be impossible to treat all of the applications of these new compounds in the textile industry, one of the largest users of a great variety of chemicals. It is believed that the foregoing discussion gives a good idea of the great possibilities of the nitroparaffins and their derivatives.

Acknowledgment is made to the Research and Technical Service Staffs of Commercial Solvents Corporation for supplying a large proportion of the data given in this paper.

MEETING, MID-WEST SECTION

THE Fall Meeting was held at the Bismarck Hotel, Chicago, Illinois, October 24th, 1942.

A. Alexander presented the intersectional paper "Training Dye Plant Workers in the Present Emergency" at the afternoon session.

Major Elliott Morrill, U.S.C.W., was the speaker of the evening. He gave a most interesting talk on "The Service." A DuPont moving picture titled "Facts on Rayon" was then presented.

Seventy-five members attended this meeting.

Respectfully submitted,

J. G. STOTT, *Secretary.*

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OBITUARY

ELGAR A. BRICK

ELGAR A. BRICK, technician and consultant for the Onyx Oil & Chemical Co., Jersey City, N. J., passed away rather suddenly last month.

ELGAR A. BRICK

Mr. Brick was born in Gloucester City, N. J., in 1867. His work in the textile field was long and varied and brought him into close contact with textile mills and dyers throughout the country. In latter years his activities were largely confined to the Middle Atlantic States. He was connected with the Onyx Oil & Chemical Company for the past 31 years. Previously Mr. Brick was with Joseph Bancroft & Son, Wilmington, Del. and the Aberfoyle Mfg. Co., Chester, Pa.

OSCAR A. GEIER

OSCAR A. GEIER, senior partner in the law firm of Richards & Geier, died suddenly November 5th, at his home in Mountain Lake, N. J.

Mr. Geier was born 62 years ago in Zurich, Switzerland, and came to the United States in 1914. He was a graduate of the Engineering College at Winterthur, Switzerland and Mittweide, Germany. He was an internationally known sportsman, his principal sports being cross-country running and bobsledding. He represented Switzerland on the bobsled team at Lake Placid in the Olympics meet of 1932. He was also a fine horseman.

Mr. Geier had been active in the American Association of Textile Technologists for many years, first as a member, then as a member of the board of governors, and for the past year as treasurer. He was active in the association until the last, having attended the November meeting on Wednesday, November 4th.

• ANNUAL MEETING, T.R.I.

The mobilization of textile research for war was the theme at the Thirteenth Annual meeting of the Textile Research Institute, held at the Hotel Roosevelt, New York, on November 13th. A large attendance of textile executives, association heads, research men, educators, and members of the armed services and WPB, showed the wide interest in war research problems and the extent to which the industry is backing this work.

At the members' meeting in the morning Fessenden S. Blanchard, president of the Institute, reviewed the progress of the preceding year, during which the resources of the Textile Research Institute and those of the Textile Foundation were converted to a war basis. This began, Mr. Blanchard said, with the organization on April 7, 1942, of the Textile Research War Council of leading association executives to serve as a basis of advice and contact for the Institute in obtaining and distributing research information on important war problems, and to aid in determining (1) what the most important problems were; (2) what had already been done on these problems, and (3) how best to organize and undertake additional research.

Mr. Blanchard pointed out that the important research problems on which the Textile Research Institute and Textile Foundation were cooperating included the following:—(1) Wool conservation in the development of fabrics for the armed services; (2) Work on the possibilities for utilization of high strength cotton yarns in order to obtain lighter weight military equipment without loss of serviceability; (3) Substitution of cotton or other fibers for manila and sisal for cordage purposes; (4) Improved aviation clothing to reduce heat losses in high altitude flying—in cooperation with the Committee on Aviation Clothing; (5) Accelerated aging of military fabrics; (6) Resistance of fabrics to ultra violet light; (7) The planning of textile research through a Textile Research Planning Committee set up by the Quartermaster's Office.

As Mr. Blanchard said, these were only a few of the many problems in which work was being done—much of it is confidential—to assist in bringing the research facilities of the industry to the aid of the armed forces. A warp sizing research on spun rayon in which seventeen member companies are participating aims to add to our understanding of sizing and its application and thus improve the running of the work in mills. A newly established Information Service is bringing together existing research knowledge on many subjects and is responsible for the survey of the waterproofing and water repellency of fabrics—just out—, which followed a widely used report on the mildewproofing of military fabrics. A report on flameproofing is in preparation.

At the morning meeting the following officers were re-elected:—Fessenden S. Blanchard, president and executive secretory; Fuller E. Callaway, Jr., Dr. Robert E. Rose, and Dr. Harold DeWitt Smith, vice presidents; and Edward T. Pickard, treasurer. Former Directors whose terms had expired were re-elected as follows:—William D. Appel, Arthur Besse, H. M. Chase, Russell T. Fisher, Ephraim Freedman, H. Grandage, Edward R. Schwarz. New Directors, which brought the number up to thirty in accordance with a revision of the by-laws adopted at the meeting, were elected as follows:—C. F. Broughton, president of Wamsutta Mills; M. Earl Heard, Dean of the Philadelphia Textile Institute; Marland C. Hobbs, vice president of Arlington Mills; Charles J. Huber, vice president of United States Testing Co.; J. Spencer Love, president of Burlington Mills; Albert L. Scott, president of Lockwood Greene Engineers; and Charles W. Sweet, vice president of Wellington Sears Co. Committee reports presented at the members meeting included those of the Textile Research Committee by W. D. Appel, chairman; the Economic Research Committee by Stanley B. Hunt, chairman; and the Publications and Publicity Committee by Douglas G. Woolf, chairman.

An inspiring address on the subject of research was delivered at the luncheon by Dr. C. E. K. Mees, vice president and director of research of the Eastman Kodak Co., of Rochester, N. Y., and K. J. A. Helder, director of export for W. O. Peake, London clothing manufacturer, who had recently arrived in this country after an exciting voyage, talked briefly about his trip and textile war time conditions in England.

The afternoon technical session on textile research war problems was led by Dr. Milton Harris, director of research of the Textile Research Institute and Textile Foundation. Participating in the discussion, which was "off the record" were William D. Appel, Chief of Textile Section of National Bureau of Standards; Lt. Col. Bestor Robinson, Research and Development Branch, Office of Quartermaster General, Washington; and Major Frank M. Steadman, Office of the Quartermaster General, Philadelphia Depot. Fabric and finishing problems were dis-

cussed, covering requirements and needs of the armed forces.

• ASA ANNUAL MEETING

Joseph L. Weiner, Deputy Director of the Office of Civilian Supply of WPB will speak at the Annual Meeting of the American Standards Association to be held Friday, December 11th at the Hotel Astor, New York. Mr. Weiner is also head of the Government's Committee on Concentration of Production in Industry.

P. G. Agnew, Secretary of the American Standards Association, who made the announcement, said that in view of the widespread interest in what lies ahead for the industries not yet completely converted to war work, the American Standards Association is opening the meeting to all who wish to hear Mr. Weiner, whether they are members of the ASA or not.

Other plans for the meeting at which Mr. Weiner will speak include a report by R. E. Zimmerman, vice-president of U. S. Steel Corporation, and president of the American Standards Association. There will also be a report by H. S. Osborne, chairman of the Standards Council, on technical acomplishments during the year; and announcement of officers for the year 1943.

Luncheon at one o'clock will be preceded by a meeting of the Standards Council in the morning and followed by a meeting of the Board of Directors in the afternoon.

• ADVISERS ON SYNTHETIC TEXTILES

The Army has appointed a special committee, composed of nationally known chemists, fiber and textile authorities to serve as a clearing house between the Quartermaster Corps and the synthetic fiber industry on all technical matters relating to the utilization of man-made fibers and textiles in Army equipment procured by the Quartermaster Corps, the War Department announced recently.

The committee, operating under the supervision of the Office of The Quartermaster General, Washington, includes: Professor E. R. Schwartz, Massachusetts Institute of Technology; Lewis Hird, Samuel Hird & Sons; William Klopman, Burlington Mills; Dr. Harold DeWitt Smith, A. M. Tenney Associates; Col. Max O. Wainer, President, The Quartermaster Board, Lt. William H. McLean and Richard R. Walton (Secretary of the Committee), both of the Research and Development Branch, Office of The Quartermaster General.

Directly responsible for the committee's activities on behalf of the War Department is Colonel George F. Doriot, Chief of the Research and Development Branch, Office of The Quartermaster General.

A technical sub-committee, operating under the main committee, has also been appointed. It consists of the following: Dr. Harold DeWitt Smith, A. M. Tenney Associates, Chairman; Dr. Ernest Benger, DuPont Company; Mr. Joseph Meierhans, J. P. Stevens Company, and C. E. Geier, Duplan Corporation.

• MOVE OFFICES

P. H. Doremus & Co., announce the removal of their offices to 632 East 19th St., Paterson, N. J. The telephone number is SHerwood 2-5661.

• DIRECTORY OF CHEMISTS

The 7th revised edition of the Classified Directory of Association of Consulting Chemists and Chemical Engineers, Inc., has recently been published. The directory may be obtained without charge by applying to the office of the association, 50 East 41st St., New York, N. Y.

• CELANESE PATENTS

Two new processes by which the safe ironing point of textile materials is increased are recognized in patents granted recently to Celanese Corporation of America.

According to United States Letters Patent No. 2,301,263, yarns or filaments or other textile materials comprising cellulose acetate or other organic derivatives of cellulose which contain free hydroxy groups are esterified with a dicarboxylic acid halide dissolved in an organic liquid which is a non-solvent for the cellulose acetate.

The process is carried out at a temperature above 100 degrees Centigrade and under such conditions that the structure of the filaments and the like is retained. This process results in a considerable increase in the safe ironing point of the material and, in addition, may render such material more water repellent.

United States Letters Patent No. 2,301,-312 relates to a process for the treatment of filaments or foils of cellulose ester materials. According to the patent, filaments or foils made of an organic ester of cellulose which contain a substantial proportion of the radicle of acetic acid and a lower proportion of a radicle of a polybasic acid are partially saponified.

This process not only raises the safe ironing point of the materials treated but does so while maintaining the tenacity of said materials.

• JOINS ARMED FORCES

J. N. Murphy of the technical service force of Quaker Chemical Products Corporation of Conshohocken, Pennsylvania, is now a member of the American armed forces.

Mr. Murphy, a graduate of the Philadelphia Textile School has been located in Quaker's Atlanta office and working from there.

• ELECTED CHAIRMAN

A. J. Kelly, Chief Chemist of the Burkart-Schier Chemical Company, has been elected chairman of the Southeast Tennessee Chemical Society, succeeding Emerson Poste.

Other new officers elected are W. T. Watkins, vice chairman; Dr. W. O. Swan, secretary-treasurer, and Dr. I. W. Grote, counselor.

• BECOMES NAVAL LIEUTENANT

George E. Prime, Plant Superintendent at Warwick Chemical Company, West Warwick, R. I., for the past three years, has just received his appointment as Lieutenant, J. G., in the United States Naval Reserve. Lieutenant Prime, a resident of Greenwood, R. I., is a graduate of the Rhode Island State College.

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WANTED: Research and development chemist, experienced in the formulation and application of wet-processing agents for the textile industry. Must be qualified by training and experience. Permanent position, with salary commensurate with qualifications. Write Box No. 412, American Dyestuff Reporter, 440 Fourth Ave., New York, N. Y.

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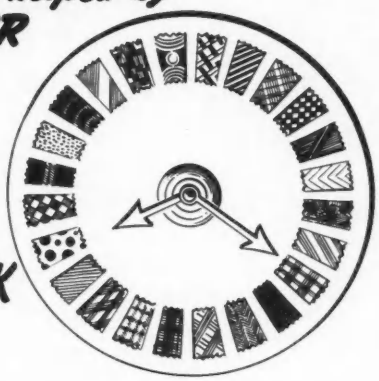

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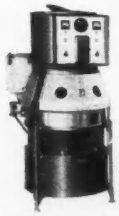

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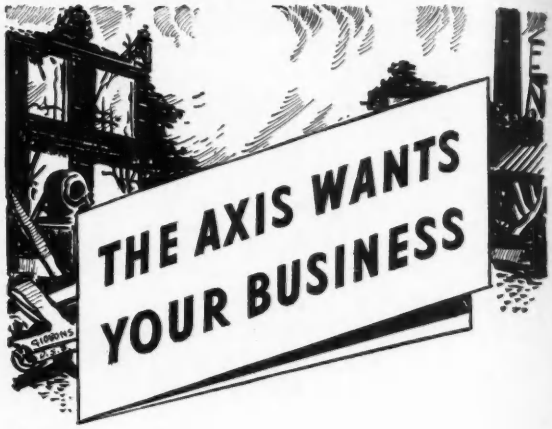

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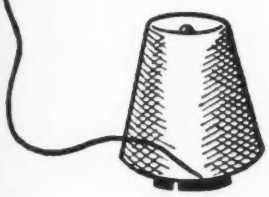

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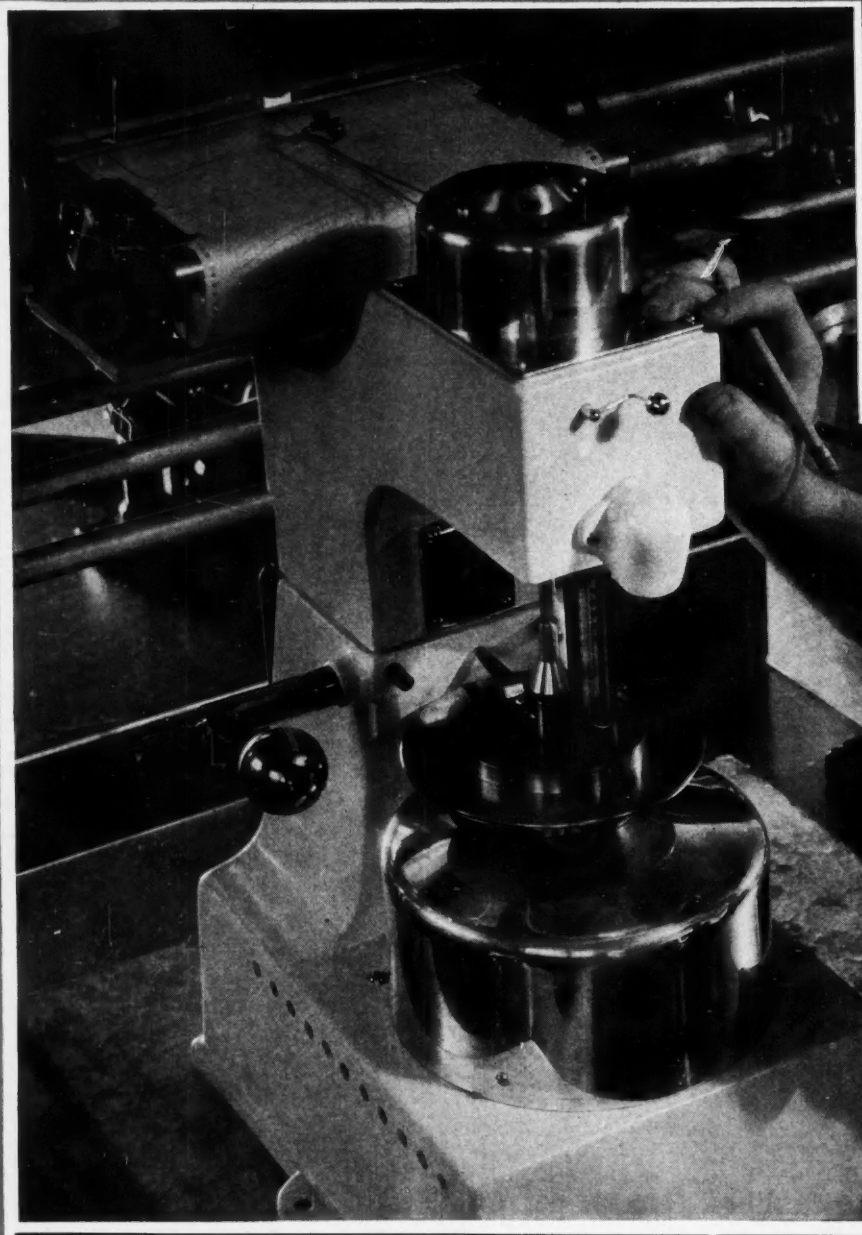

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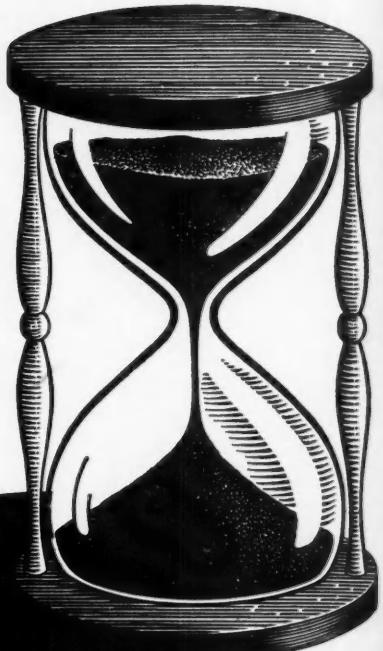

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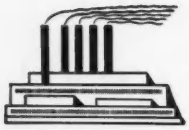

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